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CATFISH FARMING

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CATFISH FARMING

By Roy A. Grizzell, Jr., Olan W. Dillon, Jr., Edward G. Sullivan, and Lawrence V. Compton, *biologists*
Soil Conservation Service

Catfish farming is using water areas to produce crops of catfish by intensive management. This kind of farming requires constructing facilities; controlling water quality; spawning, hatching, and feeding fish; and harvesting and marketing the fish crop.

A fish farmer can grow catfish in ponds, raceways, or cages. He can market his fish in several ways—as small fish for stocking, as pan-size fish for food or for recreation fishing, or as large fish for brood stock.

This bulletin discusses the production of channel catfish, blue catfish and white catfish. They are suited to warm-water culture where water temperatures are above 70°F. for at least 4 months each year. All are native to America and have a good conversion ratio of feed to meat.

Ponds

The number and size of ponds is a personal decision. Small ponds cost more per surface acre of water than large ponds, but a fish die-off in a large pond can be a financial disaster. You can increase pond size as you gain experience.

A well-designed catfish farm could consist of about 40 surface acres of ponds with 10 to 20 acres for roads, levees, and other facilities. It would include five ponds of 1 acre each for breeding, rearing, and holding fish and five production ponds averaging 7 acres each. At least one holding vat would also be needed.

A catfish farm needs a water-distribution system, convenient drainage facilities, complete protection against floodwater, and a system of all-weather roads. Give careful attention to pond size and design, to elevation of drainpipes, and to adequacy of outlets and spillways. Select soils of good water-holding capacity. Remove all trees, stumps, and brush from the water area. Smooth the bottom and gradually slope to the harvesting area. Establish grass cover on dams and levees.

Do not locate ponds on land where pesticides have been regularly applied to crops, especially to cotton. If there is any question concerning pesticide residues, have the soils tested.

If runoff water periodically goes through a pond, you need an overflow pipe and a properly designed spillway. When water flows through a spillway, catfish may swim out of the pond. To prevent losing fish, the spillway must be wide enough that the flow is less than 3 inches deep. A screened overfall installed in the spillway keeps undesirable fish from entering the pond from downstream. Assistance with site location and pond design is available from the Soil Conservation Service.

Raceways

Catfish can be raised in raceways in areas where water is scarce and must be reused or where the land is too steep for economical pond construction. A fish raceway is a long, narrow channel especially designed for fish production and through which there is a continuous flow of water.

A raceway system includes an earthern channel up to 1,500 feet long separated into sections by weired headwalls, a water supply pond, a settling basin, an auxiliary water supply, and a pump. The design and operation of a raceway system is complex and should be undertaken only with professional guidance.

Cages

Cages are used in water where it is impractical to grow and harvest catfish by regular methods. The cages are made of corrosion-resistant wire on wood or metal frames, have a hinged door on the top for feeding and harvesting, and are floated by Styrofoam blocks. Place them in open water, anchored to posts or cables, with the cage bottom at least 1 foot above the pond bottom.

Stock the cages in April or May. Since natural food is not available to the fish use a nutritionally complete, floating feed. To insure circulation of water scrub the outside of the cages regularly with a long-handled brush. Monitor the oxygen content of the water. Check fish regularly

for diseases and parasites because fish in cages are under a higher degree of stress than those in ponds.

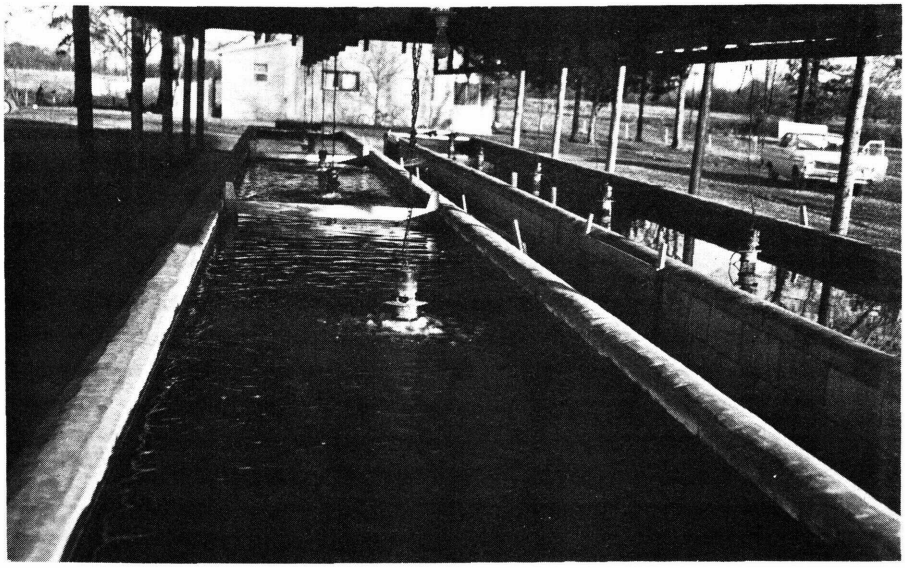
Holding Vats

Holding vats are essential in fish farming. They are used in grading fish into size classes, for holding fish for sale or temporary storage, and in treating fish to control diseases and parasites.

Holding vats are built of wood, galvanized metal, concrete blocks, poured concrete, or glass bonded on steel. A good size is 30 feet long, 4 feet wide, and 3 feet deep. The inside of concrete vats must be smoothed or painted with asphalt or epoxy paint. In summer use clean, aerated well or spring water in holding vats. Water containing more than 1 ppm of iron must be aerated or filtered before using in vats.

Water Source

A dependable supply of good-quality water is essential for catfish farming. Water from wells, springs, streams, or runoff ponds is suitable if necessary precautions are taken.



Holding vats are used for grading fingerlings, for holding fish for retail sale, for treating fish to control disease, and for holding brood fish (ARK-62,411).

The best source of water is a well. Using well water avoids problems of unwanted fish, flood hazard, pesticides, and muddiness. Your well should provide enough water to fill the ponds, replace the water lost through evaporation, and supply the water needed to replenish oxygen. Pond volume is measured in acre-feet. An acre-foot is 43,560 square feet 1 foot deep. Water from wells is measured in gallons per minute (gpm). In 1 acre-foot there are 326,000 gallons. Thus, a 1,000-gpm well yields 4.4 acre-feet in 24 hours. The yield of the well determines the size of the enterprise. A well producing 1,000 gpm of water is big enough for 40 acres of ponds. Where underground water sources are unknown or questionable, put down a test well.

Well water often has dissolved carbon dioxide or nitrogen but no oxygen—a combination deadly to fish. Disperse harmful gases and oxygenate the water by splashing the flow over baffles or through coarse screens or by spraying the water through the air before it enters the pond. A fall of 4 or 5 feet is enough to make the water safe.

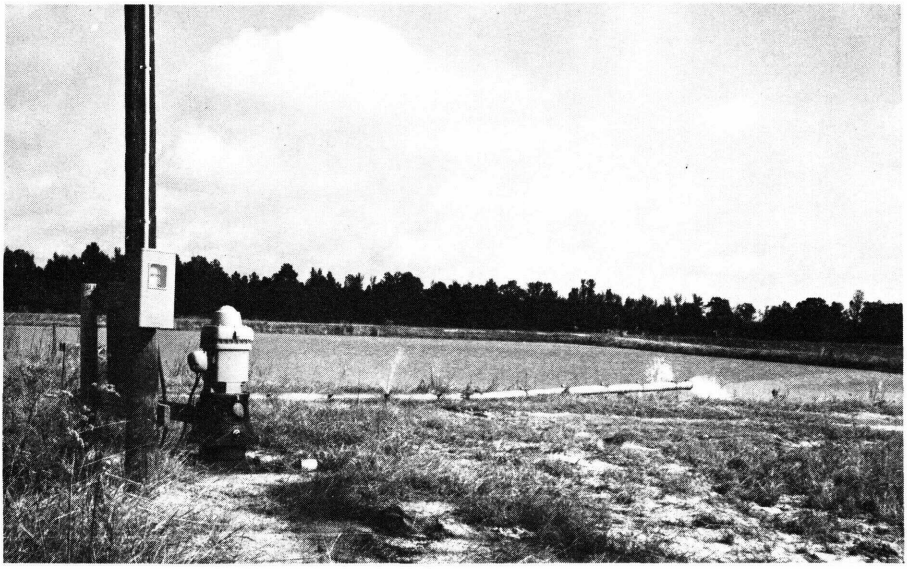
Springs are a good source of water but may contain undesirable fish. The flow in dry seasons must be known to determine their adequacy. The oxygen level in spring water is usually more than 3 parts per million (ppm), but it is a good idea to check. If oxygen is below 3 ppm, aerate the water. Kill undesirable fish with an approved fish toxicant or remove them by filtering the water.

Water taken from a pond, stream, bayou, canal, or other surface source usually contains undesirable fish. These fish will get into ponds and compete with catfish unless measures are taken to keep them out. The only known way to remove fish and fish eggs satisfactorily is to pass the water through a saran or fiberglass screen filter (mesh size 907).

Water Quality

Whatever the source of water, you must determine its pH, total hardness, and oxygen content. SCS conservationists, county agents, and state or federal biologists can assist in determining water quality and any needed remedial measures. The desirable pH range is between 6.5 and 8.5. If the pH is below 7.0 and the total hardness is less than 20 ppm, add agricultural limestone or hydrated lime. Treat water with a total hardness of more than 200 ppm with ammonium sulfate.

The minimum oxygen level for catfish ponds is 3 ppm. A lower level may cause a fish kill. Oxygen may be low at any time of the year, but serious deficiencies are most likely to occur when there is a combination of high temperatures, little wind, decaying organic materials, and cloud cover for several days. Summer thunderstorms with strong winds



A well provides the clean water needed for fish farming (ARK-62,420).

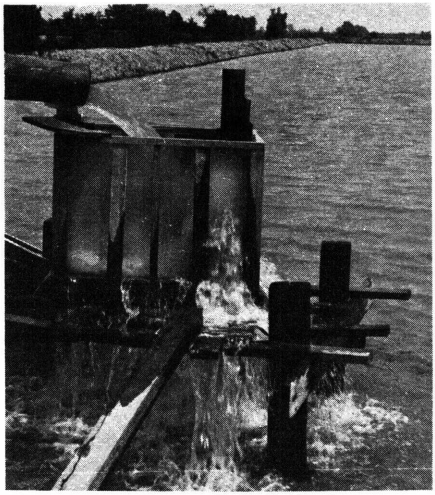
may cause a pond to "turnover"—mixing oxygen deficient water from the pond bottom with surface water, thus depleting the oxygen supply. In winter oxygen may be low when ice and snow cover the pond.

Catfish grow rapidly if properly fed and if the water temperature is 70° F. or more. Growth is slow between 60° and 70° F. Little growth occurs when water is colder than 60° F.

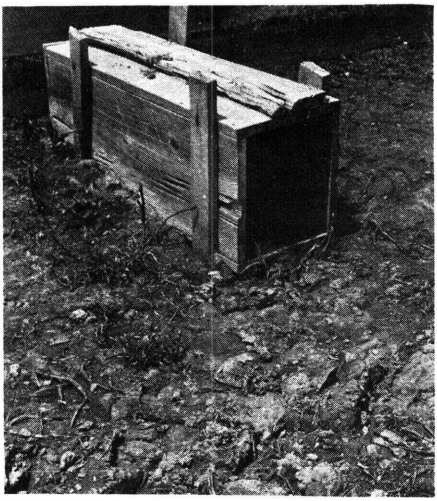
In the South deep water is not necessary for catfish farming. On flat land excavate ponds to a depth of about 2½ feet at the shallow end and gradually deepen to 4 or 6 feet at the harvesting basin. Ponds depending on runoff must be deep enough to carry catfish through a drought. Farther north, a depth of 8 feet or more may be necessary to prevent winterkill.

Selecting Catfish Species

Channel catfish *(Ictalurus punctatus)* are most commonly grown by fish farmers. They grow rapidly on feed, have excellent flavor, and bite well on sport-fishing tackle in fee-fishing ponds. Channel catfish are easily recognized by their forked tail and rounded anal fin that has less than 30 rays. Albino channel catfish (not a separate species) are useful as novelty fish in fee-fishing ponds.



A filter of saran or fiberglass keeps unwanted fish and fish eggs out of the pond (ARK-62,409).



Boxes are good spawning devices. Cans, smooth tile, or other containers are also suitable (ARK-62,415).

Blue catfish *(I. furcatus)* are often confused with channel catfish. Blues also have a forked tail but have a smaller head, an anal fin with more than 30 rays, and a slight hump at the spine of the dorsal fin. They are good sport fish. Blues grow rapidly on feed, are easy to harvest, and readily feed at the surface. They grow at about the same rate as channels the first year. After the first year, blues grow faster. When harvested they do not survive in tank trucks as well as channel catfish.

White catfish *(I. catus)* are grown with channel and blue catfish in fee-fishing ponds because they bite well in the daytime when other catfish may not. They have good flavor and can survive when oxygen levels are low. Because of a large head, the percentage of dressed weight is lower than for channels and blues.

Bullheads (*Ictalurus sp.*) are more difficult to manage than other catfish. They often overpopulate ponds and can be troublesome to a fish farmer. In some markets they sell at a lower price.

Catfish Hatcheries

For a small operation, a farmer usually buys fish for stocking. For a large fish farm, the farmer usually keeps brood fish and operates his

own hatchery. He can produce stocking-size catfish to meet his needs and sell any surplus.

A catfish hatchery needs holding ponds to keep breeders in good condition, brood ponds where pairs mate and lay their eggs, rearing ponds or troughs for the young fish, and holding vats for temporary storage or grading. Some hatcheries include hatching troughs in which the eggs are placed for hatching and raceways or cages for growing catfish.

Brood ponds usually are 1 to 2 acres. Catfish spawn best if boxes, 10-gallon milk cans, kegs, barrels, hollow logs, smooth tile, or similar devices are placed in the pond. Anchor these devices securely to the pond bottom at depths of 2 to 4 feet and 20 to 30 feet apart. Paint all metal containers inside and out with asphalt paint.

During the winter or early spring drain brood ponds and lightly disk

Brood catfish are placed in ponds in the early spring when the water temperature is about 60° F (NM-13,857).

the bottoms. If the soil is acid, apply limestone. Fill the ponds at least 30 days before spawning is expected.

Channel catfish breeders (brood fish) should be 3 or more years old, blue catfish 4 or more. Except during the spawning season keep the fish in holding ponds, separated by sex. A fisheries biologist or an experienced fish farmer can show you how to determine the sex.

Place the breeders in brood ponds in the spring when the water temperature is about 60° F. Feed them all the pellets they will eat every day. Also feed animal-protein foods such as chopped or ground animal livers or cut fish as a supplement during the prespawning period.

To prevent inbreeding, which decreases vigor and productivity, introduce new brood stock about every 4 years. Obtain healthy disease-free fish to prevent contaminating your fish farm.

Spawning usually starts when the water temperature reaches 72° F. and peaks when the water temperature reaches 80° F. After the female lays the eggs in one of the spawning devices, the male fertilizes them and fans and guards them until they hatch.

There are two methods of spawning brood fish:

1. Pond spawning is the easiest and most reliable method. Stock 10 to 20 pairs per surface acre. The lower rate is desirable if the young fish are held in the brood pond until they reach fingerling size. Males in top condition may mate successfully with a second female and care for a nest a second time. There should be at least one spawning device for each pair of fish.
2. Pen spawning requires more handling of brood fish and is best suited to farmers specializing in fingerling production. Provide an individual pen with a spawning device for each pair of brood fish. Heavy-duty vinyl-covered wire netting or fencing material 4 feet high with a 2-inch mesh is best. A rectangular pen 4 feet wide and 10 feet long is commonly used, or a 20-foot length of fence can be joined to make an oval pen. Place the pens in water 3 feet deep and embed the wire 6 inches in the pond bottom. Remove the female after she deposits the eggs.

Handling eggs and fry

There are several methods of handling eggs and fry. Each method has advantages and disadvantages. Which of these is best depends on the time and facilities available.

1. After the eggs hatch, leave the fry with the male until they reach fingerling size. If practical, remove the male when the fry become swimming fish.

2. Leave the fertilized eggs with the male until they hatch. Move the fry to troughs or rearing ponds to grow to fingerlings.
3. Remove the eggs from the spawning device as soon as they are fertilized to a hatching trough. This method is used mostly by experienced fish farmers. Troughs are built of wood, marine plywood, or metal and usually are about 20 inches wide, 10 inches deep, and 10 feet long. Place the fertilized eggs in a wire basket in the hatching trough. Run aerated water through the trough. Paddles agitate the water to keep it continually moving over the eggs as the male fish does by fanning. Eggs hatch in 7 to 10 days. Transfer the sac-fry to rearing troughs or ponds to grow to fingerling size.

Growing fingerlings

Properly stocked and fed, fish hatched in the spring are at least 6 inches long by the end of October. To obtain this growth rate, stock rearing ponds with fry or small fingerlings at the rate of 20,000 per acre. If other sizes of fish are desired, use a different stocking rate (table 1).

Stocking Production Ponds

Fish are grown from fingerling to eating size in production ponds. These ponds range from less than 1 acre to more than 100 acres. In early spring stock production ponds with fingerling catfish to grow to eating size by autumn.

The number to stock per acre depends on the size desired at the end of the growing season. Medium-size fingerlings (4 to 6 inches) stocked at 1,500 per surface acre usually average slightly more than 1 pound in a 210-day growing season. The same medium-size fingerlings stocked at 2,000 per surface acre average slightly less than a pound. Large fingerlings (10 inches long or weighing ⅓ pound) if stocked at 1,200 per surface acre average about 2 pounds at the end of the growing season. If the growing season is shorter than 210 days, you need to stock larger fingerlings.

The following stocking rates are practical:

1. In impoundments that depend solely on runoff water and if lift pumps are not available, stock 750 to 1,000 fish (4 to 6 inches) per surface acre.
2. In ponds having a sure water supply:
   a. Stock 1,500 to 2,000 fish (4 to 6 inches) per surface acre;

TABLE 1.—*Average length and weight of 1- to 2-inch fingerlings at end of first 180-day growing season*

Number stocked per surface acre	Fish [1]	Total weight of fish	Average weight per 1,000 fish	Average length of fish
	Number	*Pounds*	*Pounds*	*Inches*
40,000	30,000	600	20	4
30,000	22,500	720	32	5
20,000	15,000	900	60	6
15,000	11,250	1,050	93	7
10,000	7,500	840	112	8
5,000	3,750	675	180	9

[1] A 25-percent loss is assumed.

b. Stock 1,200 fish per surface acre if they are 10 inches long or weigh ⅓ pound; or

c. Stock 700 to 800 fish per surface acre if they are 2 years old or weigh ½ to 1 pound.

3. In ponds through which water flows at the rate of at least 150 gpm, stock 3,500 to 5,000 fish (4 to 6 inches) per surface acre. Such ponds are preferably long and narrow.

Proper stocking can be done only when the number of fish is known. It is impractical to actually count them, but you can determine the

TABLE 2.—*Average length and weight of channel catfish*

Length (inches)	Weight per 1,000 fish	Weight of individual fish
	Pounds	*Ounces*
1	1.3	—
2	3.5	—
3	10	—
4	20	—
6	60	—
8	112	—
10	328	5.25
12	509	8.2
14	850	13.6
16	1,290	21

Mechanical feeders save time and labor (ARK-62,451).

desired number on the basis of weight. This can be done in two ways: (1) Count the number of fish in a known weight. Example: If there are 100 fish in 1 pound and you want to stock 2,000 fish, weigh out 20 pounds of fish. (2) Measure the length of the fish and use table 2. Example: Fish 3 inches long weigh 10 pounds per 1,000 fish. If you want to stock 2,000 fish, weigh out 20 pounds of fish.

Feeding Catfish

Good catfish feed contains 28 to 32 percent protein, no less than 5 percent fat, 10 to 20 percent carbohydrate, and 10 to 15 percent fiber. A minimum of 8 percent of the ration should be from fishmeal and all feeds should include vitamins. The rest of the ingredients may vary according to availability.

Feeds are sold as finely ground meal and as floating or sinking pellets. Floating pellets cost more than sinking pellets but enable you to observe whether the fish are feeding. If you see no feeding activity, take steps immediately to find the cause. It may take a week or more to train channel catfish to eat floating feeds. Blue catfish readily take floating feeds. Many farmers prefer sinking pellets because they are cheaper, but there is little or no difference in fish growth between floating and sinking pellets.

Use a ⅛-inch pellet for fingerlings and a ⅜-inch pellet for fish weighing ½ pound or more. Check hardness of the pellets with each purchase. When a pellet is dropped in water, 90 percent should remain together after 10 minutes.

Fry should be fed as soon as they leave the nest or swim up in the hatching trough. Meal is used primarily for feeding fry. Moisten finely ground meal to make a mash before feeding. The meal should be similar in nutritional content to pelleted catfish feeds. Add a jar of baby food liver to each pound of mash. In troughs, feed only the amount that the fish clean up in 20 to 30 minutes. In ponds, use about 1 pound for each 2 acres of water surface to get the fry to start eating. Gradually increase the quantity of feed to the amount they will clean up in 20 to 30 minutes. After fry are feeding well, increase the amount to the equivalent of 3 percent of the total weight of the fish in the pond. Weigh a sample of fish weekly to determine total weight.

Switch to pellets when fish are 1 inch long. Use table 3 to calculate the amount to feed according to the total number of fish and increasing size (length).

TABLE 3.—*Monthly feeding schedule*[1]

[Pounds of feed per day 6 days per week, based on 3-percent-per-day program for fingerlings that average 4 inches in length at time of stocking]

Month	Amount for 300 fish (acreage not considered)	Amount based on stocking rate of 1,500 per acre
	Pounds	*Pounds*
March	0.2	0.5
April	0.5	3.0
May	1.0	7.5
June	1.5	12.0
July	2.0	15.0
August	2.5	20.0
September	3.5	25.0
October	3.5	[2]30.0
November	2.0	20.0

[1] For December, January, and February feeding rates see p. 13.

[2] Do not exceed 30 pounds per day unless water is flowing through the pond.

A general guide to the daily amount to feed fish in production ponds (based on estimated weight of fish) according to water temperature follows.

Scatter feed in 3 to 4 feet of water. Feed at the same time and place each day 6 days a week, either early in the morning or late in the afternoon.

Self feeders are good labor saving devices. Place them so feed will be dropped in 3 to 4 feet of water. Fish learn to bump the underwater release and obtain feed. Avoid overfeeding by putting only the correct amount in the feeder each day. Without auxiliary hand scattering of feed, self feeders may cause a wide variation in fish sizes. But never feed more than 30 pounds per acre a day unless water is flowing through the pond. Excessive feeding usually results in an oxygen shortage.

Check the response of the fish daily by throwing out small amounts of feed and check self feeders to see if they have been used. If fish fail to feed vigorously, something is wrong; stop feeding until you find the trouble.

If you use sinking pellets, check feed consumption by placing a 4- by 4-foot tray on the pond bottom in the feeding area before feeding. Lift the tray slowly an hour after feeding. If all the feed has not been eaten in an hour, reduce the amount fed.

To prevent weight loss, feed catfish held over winter. They are also more resistant to disease and parasites if fed. Self feeders are helpful in

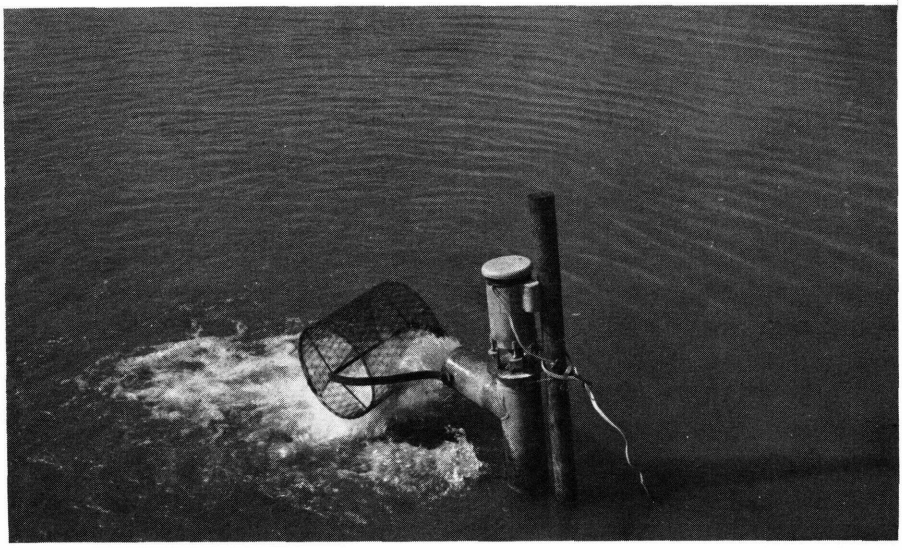
winter since at this season it is difficult to know when the fish are hungry. When the water temperature 6 inches below the surface is below 45° F., feed at the rate of one-half of 1 percent of the estimated total weight of the fish in the pond every 4 or 5 days. Feed 6 days a week at the rate of 1 percent of the weight when the water temperature is between 45° and 60° F., 2 percent when between 60° and 70° F., and 3 percent when above 70° F. In ponds holding brood fish, stock fathead minnows (*Pimephales promelas*) to provide the females the extra protein necessary for egg growth and to keep the males in good condition. If fatheads are not available, feed cut fish or liver.

Troubles and Treatments

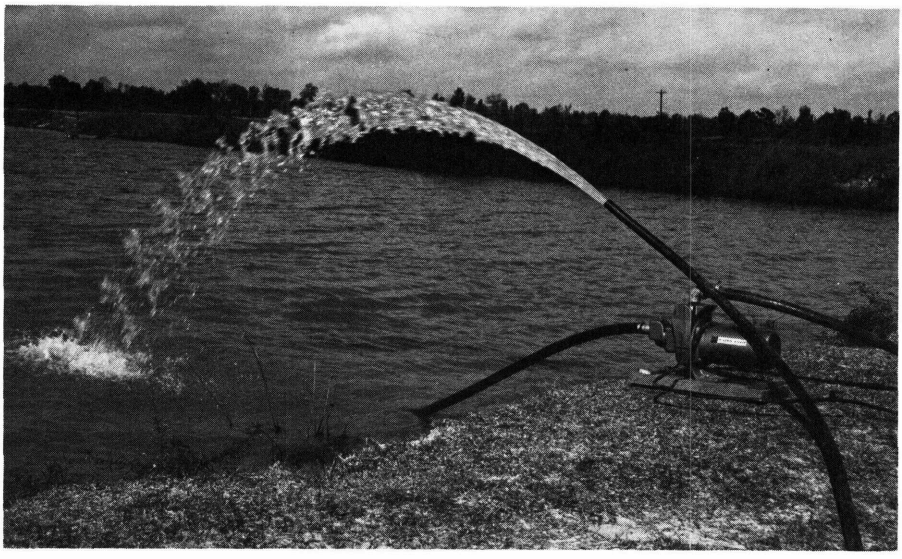
Oxygen deficiency

Catfish may fail to feed when oxygen levels drop to 3 ppm, or lower. Fish kills and disease and parasite infections are often brought about by oxygen deficiency. Be prepared to correct oxygen deficiency quickly.

A continuous flow of water through the pond, even a few gallons per minute, adds oxygen to the water. If a bottom-water release device is



A pump recirculates water to raise the oxygen level of pond water (ARK-62,452).



A lift pump is useful equipment in fish farming. Here it aerates the water (ARK-62,423).

placed in the pond, stagnant water can be removed before toxic materials accumulate.

Using a bubble chamber helps reduce oxygen problems. The chamber sits on the bottom of the pond. Air pumped into the chamber mixes with water and rises to the surface as small bubbles.

Some ways to detect and prevent oxygen shortage follow:

1. Check the pond at daybreak each day during warm weather since oxygen levels are lowest early in the morning. If fish are at the surface gasping for air, start aeration at once. If your water source is a well, pump fresh water into the pond and spray it into the air or splash it over a baffle or through a screen. You can also use a pump to recirculate pond water. Take water from 1 to 2 feet below the surface and spray or splash it. If a pump is not available, broadcast 50 to 100 pounds of superphosphate per surface acre. This stimulates the plants to manufacture oxygen. Stockpile superphosphate since there may not be time to get a supply when trouble starts. Do not use superphosphate when the water has a heavy algal bloom.
2. Fish do not feed well in oxygen-deficient water. On hot humid days, be especially cautious. Start with a small amount of feed.

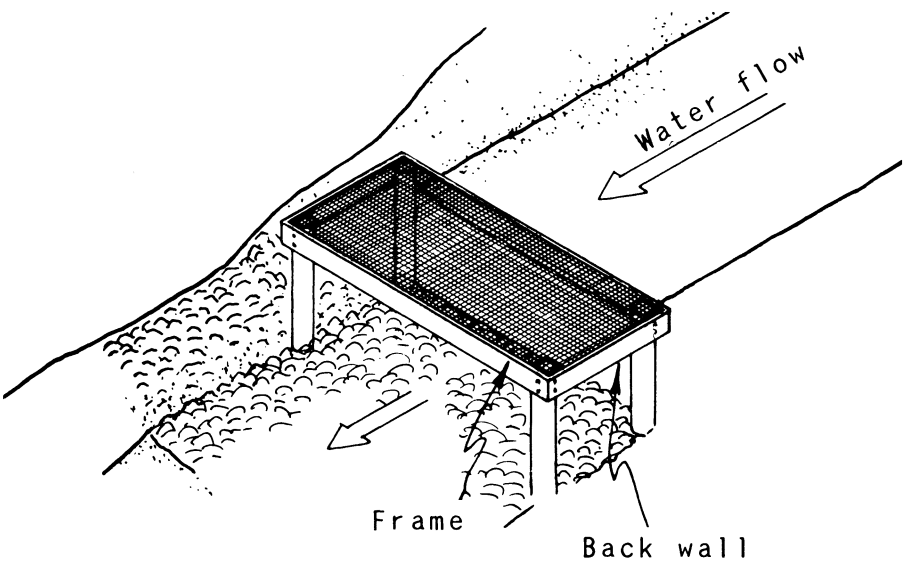
If the fish fail to feed, an oxygen shortage may be developing. Discontinue feeding until the oxygen deficiency is corrected. Aerating or changing the water may be required to correct the oxygen deficiency. Resume daily feeding with small amounts until the fish again feed vigorously.

3. Changes in water color may indicate trouble. If a heavy plankton bloom suddenly clears up or changes color (usually from green to brown), expect an oxygen shortage. Stop feeding. Flush out excessive plankton blooms if enough fresh water is available. If the pond cannot be flushed, treat it with ¾ to 1 pound of copper compound per acre foot of water. In soft or acid water use copper sulfate with caution.
4. From early spring to late fall check the water daily with an oxygen test kit, especially during hot, cloudy, still weather. If oxygen is below 3 ppm, take remedial steps immediately.

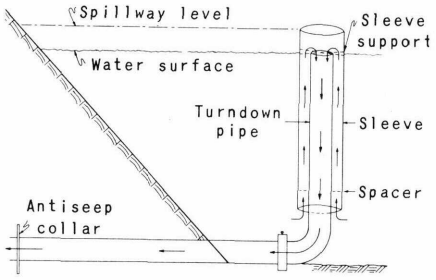
Undesirable fish

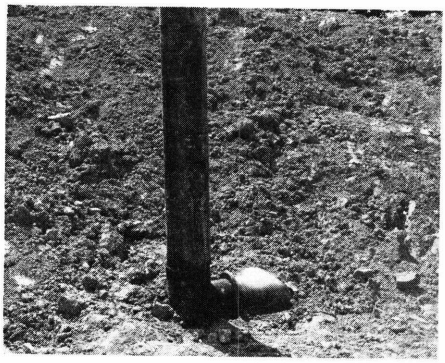
Next to oxygen deficiency, undesirable fish are the most serious problem in fish farming. They can be reduced by:

1. Draining and drying each pond after harvest. If the pond cannot be completely dried before stocking, treat the water with a fish



A screened overfall in the emergency spillway helps keep unwanted fish from entering the pond.





A bottom-water release allows oxygen-deficient water to be discharged. A turndown drainpipe can be adjusted to regulate the water level in a pond. Upright, it keeps the pond full; down, it drains the pond. (ARK-62,423).

toxicant to be sure no undesirable fish are carried over. Before restocking make certain that no fish toxicant remains in the water.

2. Using well water instead of surface or spring water.
3. Using a turndown drainpipe. When the drainpipe is upright, fish cannot enter the pond unless the flow of water is reversed.
4. Filtering surface water, if it must be used, through a saran or fiberglass screen.
5. Stocking bass to prey on undesirable species of fish. Stock bass equal or nearly equal in size to the catfish at the rate of 50 to 100 per acre.
6. Using selective chemicals that eliminate undesirable fish but do not harm catfish.
7. Using an overflow pipe and a screened overfall in the spillway in ponds receiving enough surface drainage to cause spillway action.
8. Remove any buffalofish or carp with selective fish toxicant.

Muddy water

Catfish can be grown in muddy water if fed daily. Natural food organisms are scarce in muddy water and lower productivity results.

Proper pond design and construction, and a good grass cover on banks, dams, and levees are ways to avoid muddy water.

Ponds can be cleared of muddy water in the following ways:

1. Break bales of hay (7 to 10 per surface acre) into blocks and place them in shallow water along the edge of the pond. Repeat treat-

ment after 10 days if necessary. Do not use hay in hot weather—its decay may cause a serious loss of oxygen.

2. On each acre of pond surface scatter a mixture of 75 pounds of cottonseed or soybean meal and 25 pounds of superphosphate per acre. Repeat treatment after 10 days if necessary. Do not use this treatment during hot weather.
3. Scatter gypsum on the pond surface. Use 200 pounds per acre if the water is slightly turbid. As much as 800 pounds per acre may be needed in very muddy water. Repeat at 7- to 10-day intervals until water clears.

Waterweeds

Shallow water allows waterweeds to get a start. Good pond design provides a 2½ to 3 foot minimum depth. Ponds should be filled with water as soon as possible to prevent most weed seeds from germinating.

A few herbicides have been approved for aquatic weed control under certain conditions. Use such chemicals according to the recommendations and restrictions stated on the herbicide label. If the label does not include instructions for a proposed use, such as aquatic weed control in fish ponds, the product has not been registered for that purpose and should not be used. Use may result in the fish being condemned for human consumption.

Diseases and parasites

Watch for changes in normal fish behavior. If you see sick or dead fish, remove them promptly and flush the impoundment with fresh water if available.

Watch for reduced vigor or failure to feed, lesions or sores, and parasites. If you find a disease or parasite, start treatment immediately. If troubles persist consult a fisheries biologist or experienced fish farmer.

Treat fish from outside sources for disease and parasites before stocking. Use only approved chemicals and no more than one at a time. Observe the same precautions for chemicals used to treat fish diseases and parasites as for herbicides. Using unapproved chemicals could result in the fish being condemned for human consumption.

Shock

Catfish are extremely sensitive to sudden changes in water temperature. When moving catfish from one body of water to another, raise or lower the temperature of the water in the container in which they are transported to approximate that of the water into which they are placed. Temper the water in the container by slowly mixing water from the

receiving pond with that in the container. If there is a great difference in temperature, the mixing should take about an hour.

Predators

Newly hatched fry, especially in brood ponds, are sometimes eliminated by predaceous insects. To control insects, pour a mixture of 1 quart of motor oil (SAE 30) and 2 to 4 gallons of diesel oil per surface acre on the surface of each brood pond just before or immediately after egg laying. Repeat if necessary. Pour the oil mixture on the pond when there is a slight breeze that will carry it across the surface. This mixture will not harm the fish.

Water snakes prey on catfish and can be eliminated by shooting. Keeping grass mowed around edges of ponds makes the area less attractive to snakes.

Adult frogs feed mainly on insects but occasionally eat small fish. Tadpoles, however, compete with catfish for feed. Frogs can be controlled by shooting or gigging and by removing the egg masses from ponds.

Off-flavor in fish

A serious problem in food-fish farming is occasional off-flavor of the fish. Off-flavors occur most frequently in late summer when water temperatures are high, the largest amount of feed is being used, and algal blooms are dense.

Before harvesting a pond, catch, clean, cook, and eat several fish to check for flavor. If you detect any off-flavor, delay harvesting until you determine and correct the cause. If you detect any off-flavor after fish are harvested, hold them in vats with running fresh water for several days.

Some of the causes of and remedies for off-flavor are:

1. Algal blooms. Reduce blooms by flushing or by treating ponds with copper sulfate. For information on using copper sulfate, consult your local SCS technician, county agent, or state or federal biologist.
2. Muskgrass. This alga grows from the pond bottom and has a strong musty odor. Fish grown in water with muskgrass often have the same disagreeable flavor in their flesh. If ponds are well constructed and high fertility is maintained, this plant seldom flourishes. If muskgrass occurs, treat the pond with copper sulfate.
3. Overfeeding. Fish quickly absorb the taste of sour water caused by spoiled feed. Check feed consumption regularly. If sour water causes off-flavor, flow fresh water into the pond and draw water from the pond bottom.
4. Other organic matter. Decaying organic matter, especially from

trees, may give fish a musty taste. Remove all trees, stumps, and roots from ponds before filling with water. Also keep leaves and animal manure from getting into ponds.

5. Chemicals. Agricultural chemicals, especially when applied as spray, may drift over ponds and cause an off-flavor in fish or even kill them. To reduce this hazard, use ground spray equipment or be certain that wind drift does not blow chemicals toward ponds.

Harvesting

Do not feed fish the day before harvest. The digestive tract of fish should be empty when they are handled or hauled.

It is best to harvest during cool weather. Cool water holds more oxygen. Water at or near the pond bottom may be oxygen deficient during the summer. The harvesting process may mix bottom water with top water and cause a lethal condition to develop rapidly. To reduce this hazard pump aerated water into the pond the day before harvesting and draw the surplus water off the bottom.

Most harvesting seines are made of 1-inch-bar-mesh nylon and are 8 to 10 feet deep from floats to footrope. For each 2 feet of pond width you need 3 feet of seine. On soft bottoms, a 30-strand sisal-twine footrope is more satisfactory than a lead line.

Harvesting is easier with a boom operated from a truck on the levee (ARK-62,453).

Ponds that have a firm smooth bottom gradually deepening to a harvesting basin are easily seined. Stretch the seine from bank to bank. If you attach a long rope to the bottom of each end, the seine is easier to haul. Trucks, tractors, or winches are often used to pull long seines. In well-constructed ponds you can harvest 70 to 90 percent of the fish with good equipment. Lower the water to concentrate the remaining fish in the harvesting basin.

Carrying fish from a pond to a tank truck is back-breaking labor. Mechanical equipment such as a power hoist mounted on a truck or tractor, an elevator, or similar device makes the job much easier.

Fee fishing is a way to partially harvest a pond. Fees are usually charged by the pound for the fish caught. The most successful combination for fee fishing has been channel, blue, and white catfish.

Catfish Economics

Many of the costs in catfish farming are set at the time the enterprise is started. That is the time to examine the alternatives in size and kind of enterprise and the possibilities for expansion.

Pond construction is a major expense. The kind you build may be the most important decision you make in catfish farming. Costs depend on the kind of equipment used, the cost of moving soil, and the size and shape of the pond. Small rectangular or odd-shaped ponds are more expensive to build than large square ponds. Pond maintenance is a recurring cost.

Water is another major cost item. Wells, which are generally preferred as a source, vary in cost according to size, depth to water table, geologic structure, and other factors. A 6-inch well that produces 1,000 gallons per minute usually provides enough water for 40 acres of ponds.

Feed costs vary widely, depending on volume purchased, distance shipped, and type (floating or sinking). About 3,000 pounds of feed are needed to produce 1,500 pounds of fish.

Markets available to a catfish farmer vary. Selling to a combination of markets often yields the most profit. Some markets are:

1. Fingerlings. Fingerlings are priced according to size, quality, and quantity.
2. Brood fish. There is a limited market for high-quality breeders.
3. Fee fishing. Fish are caught with bait and tackle by the consumer who pays a fee, by the pound, for the fish caught. Fee-fishing ponds are usually located near large population centers where there is a demand for this kind of recreation.

Fee-fishing ponds are a major outlet for farm-raised catfish (TENN-1,049).

4. Wholesale. This market requires large volumes of fish to supply cooperatives, processors, jobbers, and other large-volume outlets. Farmers usually sell fish at a lower price per pound to such markets, but their marketing costs are usually lower.
5. Retail. This market is usually for small-volume sales. Fish are sold live or dressed. Both market costs and sale prices are usually higher for small lots.

A fish farmer should analyze all costs—those for taxes; labor; pond construction and maintenance; water-supply development, including pumping and quality control; feed; and harvesting and marketing.

All programs and services of the U.S. Department of Agriculture are available to everyone without regard to race, creed, color, sex, or national origin.

CAUTION

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels. Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift or in ways that may leave illegal residues.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump or crush and bury them in a level, isolated place.

NOTE: Some states have restrictions on the use of certain pesticides. Check your state and local regulations. Also, because registrations of pesticides are under constant review by the U.S. Department of Agriculture, consult your SCS conservationist, county agricultural agent, or state or federal biologist to be sure the intended use is still registered. The use of nonapproved chemicals could result in condemnation of the fish for human consumption.

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